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NASA-15732 (MARCH 2003)  
NATIONAL AERONAUTICS NASA  
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(September 1999)  
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SECTION 15732

PACKAGED AIR-CONDITIONING UNITS  
03/03

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NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This section covers packaged-air conditioning units.

Drawings or schedule shall show cooling and dehumidification requirements, capacity, mounting details, power connections, etc.

Heating provisions are not included.

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PART 1 GENERAL

1.1 REFERENCES

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NOTE: The following references should not be manually edited except to add new references. References not used in the text will automatically be deleted from this section of the project specification.  
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The publications listed below form a part of this section to the extent referenced:

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 210/240	(1994) Unitary Air-Conditioning and Air-Source Heat Pump Equipment
ARI 340/360	(1993) Commercial and Industrial Unitary Air-Conditioning Equipment and Heat Pump Equipment
ARI 450	(1999) Water-Cooled Refrigerant Condensers, Remote Type

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11 (1990) Load Ratings and Fatigue Life for  
Roller Bearings

ABMA 9 (1990) Load Ratings and Fatigue Life for  
Ball Bearings

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING  
ENGINEERS (ASHRAE)

ASHRAE 52.1 (1992) Gravimetric and Dust Spot  
Procedures for Testing Air-Cleaning  
Devices Used in General Ventilation for  
Removing Particulate Matter

ASHRAE 90.1 (1999) Energy Conservation in New Building  
Design

ASME INTERNATIONAL (ASME)

ASME BPVC SEC VIII D1 (1995) Boiler and Pressure Vessel Code;  
Section VIII, Pressure Vessels Division 1  
- Basic Coverage

U.S. DEPARTMENT OF ENERGY (DOE)

DOE CE-3 (2001) How to Buy an Energy-Efficient  
Commercial Unitary Air Conditioner

DOE RA-1 (2000) How to Buy an Energy-Efficient Room  
Air Conditioner

1.2 SUBMITTALS

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**NOTE: Review submittal description (SD) definitions  
in Section 01330 SUBMITTAL PROCEDURES and edit the  
following list to reflect only the submittals  
required for the project. Submittals should be kept  
to the minimum required for adequate quality  
control. Include a columnar list of appropriate  
products and tests beneath each submittal  
description.**

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The following shall be submitted in accordance with Section 01330 Submittal  
Procedures in sufficient detail to show full compliance with the  
specification:

SD-03 Product Data

Equipment and Performance Data shall be submitted for packaged

air-conditioning units in accordance with paragraph entitled, "General Requirements," of this section.

Manufacturer's catalog data shall be submitted for the following items:

- Air-Conditioning Systems
- Compressor
- Cooling Coil
- Fans
- Controls
- Casing
- Filters
- Condenser
- Vibration Isolation

#### SD-02 Shop Drawings

Fabrication drawings shall be submitted for the following items consisting of fabrication and assembly details to be performed in the factory.

- Packaged Unit
- Compressor
- Cooling Coil
- Controls
- Casing
- Condenser

Installation Drawings shall be submitted for packaged air-conditioning units in accordance with paragraph entitled, "Installation," of this section.

#### SD-07 Certificates

Listing of Product Installations shall be submitted for packaged air-conditioning units in accordance with paragraph entitled, "Installation," of this section.

#### SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted in accordance with paragraph entitled, "Operation and Maintenance," of this section.

### 1.3 GENERAL REQUIREMENTS

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**NOTE: If Section 15003 GENERAL MECHANICAL PROVISIONS is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted. If Section 15072 VIBRATION ISOLATION FOR AIR CONDITIONING EQUIPMENT is not included in the**

project specification, applicable requirements  
therefrom should be inserted and the second  
paragraph deleted.

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[Section 15003 GENERAL MECHANICAL PROVISIONS applies to work specified in this section.]

[Section 15072 VIBRATION ISOLATION FOR AIR CONDITIONING EQUIPMENT applies to work specified in this section.]

Equipment and Performance Data shall be submitted for packaged air-conditioning units consisting of use life, power ratings, capacity ranges, face area classifications, and rotational velocities.

## PART 2 PRODUCTS

### 2.1 MANUFACTURED UNITS

#### 2.1.1 Window-Type, Packaged, Self-Contained (WAC)

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**NOTE: Unit sizes to 23,000 British thermal units  
(Btu) 6740 watt per hour.**

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Packaged unit shall be a window-type, self-contained assemblage that includes hermetic compressor, fan(s), motor drives, coils and controls for fully automatic operation, intercomponent piping and wiring, totally enclosed weatherproof casing, and frame mounting ready for power connection.

Units shall use a non-chlorofluorocarbon (CFC) refrigerant and be shipped with a refrigerant holding charge.

Unit shall be window type through wall.

Unit shall be Underwriters Laboratories (UL) listed.

Rating shall be at unit maximum speed.

Controls shall be located [on front face of unit] [with remote thermostat with on/off/fan selector] [at a remote panel]. Conditioned-air circulating fan control shall be [two] [three]-speed [gradually adjustable] [solid-state].

Unit shall have provisions for admitting controlled amounts of outside air as makeup and for exhausting internal air.

Units shall have efficiencies in accordance with the recommended levels specified in DOE RA-1 and ASHRAE 90.1.

Evaporator fan shall be centrifugal type with [\_\_\_\_\_] type blades.

Condenser fan shall be [centrifugal] [propeller] type.

Evaporator and condenser fans shall be driven by [a common motor with double shaft] [individual motors].

Evaporator coil shall be nonferrous construction with [\_\_\_\_\_] [aluminum] [copper] plate fins per inch millimeter, mechanically bonded to staggered [aluminum] [copper] tubing [\_\_\_\_\_] inch millimeter in diameter.

Condenser coil shall be nonferrous construction with [\_\_\_\_\_] [aluminum] [copper] plate fins per inch, millimeter, mechanically bonded to staggered [aluminum] [copper] tubing [\_\_\_\_\_] inch millimeter in diameter.

Unit shall have an internally mounted [reusable] [throwaway] filter, minimum [\_\_\_\_\_] inch(es) millimeter thick with minimum face area of [\_\_\_\_\_] square [inches] [feet] millimeter.

Outlet grilles shall be constructed to permit adjustable horizontal and vertical flow.

#### 2.1.2 Console-Type, Packaged, Self-Contained (CAC)

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**NOTE: Referenced standard permits actual capacity of furnished unit to be 95 percent of nameplate capacity and the power input to be 105 percent of rated input.**

**Unit sizes 20,000 to 120,000 Btu 5861 to 35168 watts per hour.**

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Packaged unit shall be self-contained, floor-mounted assemblage that includes compressors, fans, motor(s), drives, coils, water-cooled condenser, air filters, controls for fully automatic operation, intercomponent piping and wiring, and a single casing suitable for exposed-to-view office locations ready for field terminal connections.

Units shall use a non-cfc refrigerant and be shipped with a refrigerant holding-charge.

Unit shall be [ARI Classification RCU-W-CB, evaporator/blower unit, and remote air-cooled condensing unit with capacities ranging from [20,000 to 120,000 British thermal units 5860 to 35170 watts]] [Evaporator/blower unit with plenum, modified to be self-contained, conforming to ARI 210/240].

Units shall have efficiencies in accordance with the recommended levels specified in DOE CE-3.

[Room sensible cooling effect requirements of ARI 210/240 shall be 70 percent.]

Rating shall be at unit maximum speed.

Conditioned-air circulating fans shall be centrifugal type with [\_\_\_\_\_]

type blades.

Evaporator coil shall be nonferrous construction with [\_\_\_\_\_] [aluminum] [copper] plate fins per inch millimeter mechanically bonded to [aluminum] [copper] tubing [\_\_\_\_\_] inch millimeter in diameter.

Condenser shall be water-cooled type and shall be contained within the enclosure.

Outlet grilles shall be constructed to permit adjustable horizontal and vertical flow.

[Unit shall be fitted with automatic cooling-water control valves.]

#### 2.1.3 Remote-Split-Type, Packaged, Self-Contained (RSAC)

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**NOTE: Heating provisions are not included. Air-and water-cooled condensers are included.**

Referenced standard permits actual capacity of furnished unit to be 95 percent of identification plate capacity and a power input 105 percent of rated input.

Type I unit range 20,000 to 120,000 Btu/hr 5860 to 35170 watts; Type II unit range 35,000 to 180,000 Btu/hr 10260 to 52755 watt/hr; Type III unit range 31,000 to 240,000 Btu/hr 9085 to 70340 watt/hr. Style A units are console type with plenum; Style B units have duct connections.

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Air-conditioner shall consist of matched assemblies. Packaged unit shall be provided complete with frame and enclosure, interconnecting piping and wiring, necessary controls and safety devices, and operating charge of oil. Unit shall be ready for full-capacity operation after removal of shipping protection, connection to remote compressor/condenser or condenser, charging, and connection to utilities. System shall be completely charged in the field. Refrigerant shall be R-22. Units shall be shipped with a refrigerant holding-charge.

[Unit shall be ARI Classification RCU-A-CB, ARI 210/240, evaporator/blower unit and remote air-cooled condenser and compressor, with capacities ranging from 20,000 to 120,000 Btu 5860 to 35170 watt per hour.]

[Unit shall be RCU-W-CB, ARI 210/240 ARI 340/360, evaporator/blower unit and remote water-cooled condenser and compressor, with capacities ranging from 35,000 to 180,000 Btu 10260 to 52755 watt per hour.]

[Air-cooled units shall have efficiencies in accordance with the recommended levels specified in DOE CE-3.]

[Water-cooled units shall have efficiencies in accordance with the

recommended levels specified in DOE CE-3.]

[Unit shall be RC-A, ARI 340/360, evaporator/blower, compressor unit and remote air-cooled condenser unit, with capacities ranging from 31,000 to 240,000 Btu 9085 to 70340 watt per hour.]

[Evaporator/blower unit shall be floor-mounted console type with plenum.]

[Evaporator/blower unit shall be floor-mounted with connections for ductwork.]

#### 2.1.3.1 Compressor

Compressor shall be 1,750-revolution per minute (rpm) [semihermetic] [hermetic] type with internal crankcase sight glass and protected motor. A 3,500-rpm compressor is acceptable in units of 20 tons 70340 watt and less.

Unit shall be capable of continuous operation under ARI, "Maximum Operating Conditions" and "Load Temperature Operations".

Compressors shall be provided with capacity reduction devices to produce automatic-capacity reduction of at least 66 percent in two equal steps. Compressors shall start with capacity reduction devices in the unloaded position. If standard with the manufacturer, two equal-sized compressors shall be provided in lieu of a single compressor, and shall operate in completely independent refrigerant circuits, shall be actuated by capacity control relays interlocked with a time sequence switch, and shall start unloaded or with gas pressures across the compressor equalized.

[Compressors shall be provided with high/low pressure safety cutoff. Compressor shall be equipped with reversible oil pump for lubrication, an oil-pressure-failure switch and gage, crankcase heaters, suction and discharge flanged valves, head pressure, and suction pressure gages with shutoff valves. System selection shall limit the compressor power input to 1.2 kilowatts per ton of refrigeration at standard ARI conditions. Compressor shall be mounted on spring-type vibration isolators.]

#### 2.1.3.2 Cooling Coil

[Separate cooling-coil circuits shall be provided for each compressor in the unit] [Pilot expansion valves shall be furnished]. For compressors with capacity reduction, the associated coil shall be provided with a separate circuit, liquid solenoid valve, and an expansion device for each two stages of capacity reduction. For each compressor of a dual-compressor unit, the associated coil shall be provided with a protected, insulated drain pan. Tubes shall be seamless copper, and fins shall be [copper] [aluminum], mechanically bonded to the tube at 12 fins per inch 25 millimeter, maximum. Coils shall be [vertical] [set at an angle] and shall be equipped with liquid-feed distributors to ensure equal feed to each refrigerant circuit. Coils shall be tested at 400 pounds per square inch (psi) 2760 kilopascal at the factory and completely dehydrated. Air flow shall be limited to 500 feet per minute (fpm) 2.54 meter per second. Design shall preclude carryover of water.



#### 2.1.3.3 Fans

Centrifugal-type fans with [\_\_\_\_\_] type blades shall be provided in each fan section. Fans shall be [mounted on a common shaft] [on two shafts if each shaft is driven by double belts and a single double-end motor]. Bearings shall be antifriction type, manufactured from vacuum processed alloys. Bearing shall have [ABMA 9] [ABMA 11], L-10 life expectancy rating of 40,000 hours under service load conditions. Fans shall be statically and dynamically balanced. Fans shall be V-belt driven by constant-speed motor of sufficient size that the brake power rating shall not exceed the nominal motor rating. Adjustable sheave shall provide not less than 20 percent fan-speed adjustment. Sheave size shall be selected so that fan speed at the approximate midpoint of the sheave adjustment will produce the specified air quantity.

#### 2.1.3.4 Casing

Outer casing shall be constructed of insulated 18-gage 1.3 millimeter metal panels adequately reinforced with [angles] [formed metal frame], and provided with easily removable access panels located for access to all parts of the equipment. Corners shall be rounded to provide a neat appearance. All metal surfaces shall be Bonderite treated, phosphatized, and have a baked enamel finish. Return air inlet grilles located on the front face of the unit shall be an integral part of the unit casing. Casing and insulation shall be designed to limit noise and vibration within acceptable levels.

Outlet grilles shall be constructed to permit adjustable directional flow in both horizontal and vertical planes.

#### 2.1.3.5 Controls

A switch with fan/off/cool positions, shall be mounted [in the unit] [with the remote thermostat]. Thermostat shall be remotely mounted where shown on the drawing. Other controls, including motor starter or contactors and safety controls, shall be mounted inside the enclosure and wired at the factory. Motor starters shall be magnetic across-the-line type. Enclosures for motor starter shall be general purpose. Where two or more compressors are used, time-delay relays shall be provided for sequence starting.

#### 2.1.3.6 Filters

Filters shall be located in the filter return air fixture [in the rear of the casing] [on the inside of the front casing]. Filters shall limit air velocities to 500 fpm 2.54 meter per second. Filter shall have an average efficiency of not less than 20 percent based on ASHRAE 52.1.

[Filters shall be [\_\_\_\_\_] inch millimeter thick panel, permanent, cleanable, impingement type, all-metal construction. Frame metal shall be galvanized steel not less than 20-gage 1.0 millimeter with mitered, reinforced corners. Filter medium shall be galvanized, corrugated metal. Aluminum filters shall be used if the medium is the herringbone type (expanded aluminum metal will not be accepted).]

[Filters shall be [\_\_\_\_\_] inch millimeter thick panel, glass-fiber type, housed in a fiberboard casing between metal grids. Stiffener bar shall be provided for additional support. Filtering medium shall be formed of continuous interlaced glass filaments. Fiber shall be coated with a nonflammable fluid jell that forms an adhesive film to hold collected dust.

Fluid jell shall not drip at temperatures below 150 degrees F 66 degrees C.]

#### 2.1.3.7 Air-Cooled Condenser

Air-cooled condenser with vertical discharge, in a weather-protected casing, shall be suitable for installation remote from air-conditioning unit. Air inlet and discharge grilles shall be provided with galvanized wire-mesh birdscreens.

Condenser coil shall be an extended surface fin-and-tube type, constructed with [copper] [aluminum] tubes with [\_\_\_\_\_] [copper] [aluminum] fins per inch 25 millimeter mechanically bonded to coil. Entire refrigerant circuit shall be dehydrated and sealed at the factory. Coil shall be designed for the refrigerant used in the air conditioner. R-22 condensers shall be designed for working pressure of not less than 300 psi 2070 kilopascal and shall be factory tested at not less than [400] [2760] [\_\_\_\_\_] psi kilopascal.

Fans shall be [centrifugal] [propeller] type. Fans shall be [belt-driven] [directly connected to low-speed (1,200 rpm maximum) electric motors]. Belt drive shall be provided with guard and adjustable sheaves to provide not less than 20 percent fan speed adjustment. Sheaves shall be selected to provide the capacity indicated at the approximate midpoint of the adjustment.

Electric motor shall be totally enclosed. Motor starter shall be magnetic across-the-line type within a weather-resistant housing.

Condenser enclosure shall be constructed of [not less than 18-gage 1.3 millimeter sheet steel] [aluminum adequately reinforced and braced], with access panels and with rust-inhibitive baked enamel or galvanized finish.

[Condensing pressure control shall be accomplished by an electronic solid-state control system that will modulate speed of condenser fan motor from 0 to 100 percent by fan cycling.]

[Condensing pressure control shall be accomplished by an electric thermostat that cycles the condenser fan motor.]

[Condensing pressure control shall be accomplished by a head pressure switch that cycles the condenser fan motor.]

[Condensing pressure control shall be accomplished by [fan cycling] [modulation of dampers located in the airstream].]

[Condensing pressure control shall be accomplished by [condenser-coil flooding system] [by modulation of dampers located in the airstream].]

#### 2.1.3.8 Water-Cooled Condenser

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**NOTE: The following covers remote condensers for  
process or comfort air-conditioning systems.**

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Water-cooled condensers shall include all necessary openings, water and refrigerant connections, purge valves, relief devices, refrigerant valves, liquid-level indicating device, and support provisions.

Condenser shall conform to ARI 450, ASME BPVC SEC VIII D1 [and so stamped].

[When a condenser is being used as a combination receiver, the pump-down capacity shall be 80 percent of the available condenser volume.]

[Unit shall be selected for water velocities not in excess of 7 feet 2.1 meter per second and a fouling factor of 0.0010.]

[Condensing surface between halogen refrigerant and cooling water shall be [copper] [brass].]

[Condensing surface between halogen refrigerant and cooling water shall be copper; tube sheets shall be nonferrous metal.]

[Condensers with a refrigeration capacity of 10 tons 35 kilowatt and under shall be [shell and coil] [shell and U-tube] [shell and tube] construction. Coil joints shall be [brazed] [silver] soldered.]

[Condenser shall be [shell and coil] [shell and U-tube] [shell and tube] construction.]

[Condensers with a refrigeration capacity of 10 tons 35 kilowatt or more shall be shell and tube cleanable type construction, and tubes shall be [rolled] [brazed] into tube sheet.]

[Condenser shall be shell and tube cleanable type construction, and tubes shall be [rolled] [brazed] into tube sheet.]

Intermediate tube supports shall be provided so that distance between straight-tube supports does not exceed [3] [900] [\_\_\_\_\_] feet millimeter for copper tubes and [4] [1200] [\_\_\_\_\_] feet millimeter for brass tubes. Supports shall be fitted to the tubes in a manner to preclude corrosion, vibration, and abrasion.

## 2.2 COMPONENTS

### 2.2.1 Vibration Isolators

Vibration isolation provisions shall conform to requirements specified in Section 15072 VIBRATION ISOLATION FOR AIR CONDITIONING EQUIPMENT.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Equipment shall be installed in accordance with manufacturer's recommendations.

Listing of Product Installations shall be submitted for packaged air-conditioning units showing a minimum of 5 installed units, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. List shall include purchaser, address of installation, service organization, and date of installation.

Installation Drawings shall be submitted for packaged air-conditioning units in accordance with referenced standards in this section.

### 3.2 TESTING

#### 3.2.1 Quality Control

Components of the air-conditioning systems shall be tested and rated as a system in accordance with ARI 210/240.

### 3.3 OPERATION AND MAINTENANCE

Contractor shall submit [6] [\_\_\_\_\_] copies of the Operation and Maintenance Manuals 30 days prior to testing the packaged air-conditioning units. Data shall be updated and resubmitted for final approval no later than 30 days prior to contract completion.

-- End of Section --